



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/835,820	04/17/2001	Tomohisa Hoshino	P 280192 EL00028CDC	5539

909 7590 01/16/2002

PILLSBURY WINTHROP LLP
1600 TYSONS BOULEVARD
MCLEAN, VA 22102

EXAMINER

LUU, CHUONG A

ART UNIT

PAPER NUMBER

2825

DATE MAILED: 01/16/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/835,820

Applicant(s)

HOSHINO ET AL.

Examiner

Chuong A Luu

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: ____

DETAILED ACTION

PRIOR ART REJECTIONS

Statutory Basis

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The Rejections

Claims 1, and 3-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U.S. 5,665,659) in view of Akahori et al. (U.S. 5,296,404)

Lee discloses a method for forming metal layer of a semiconductor device by

(1) forming a barrier conductor layer (67) on a substrate (61);

forming, after said step of exposing said barrier conductor layer to said first

reducing gas atmosphere, a metal film on said barrier conductor layer

(see column 7, lines 29-38)

exposing said metal film to a second reducing gas atmosphere at an elevated

substrate temperature (see columns 7 and 8, lines 62-67 and lines 1-13,

respectively;

(3) wherein said step of exposing said barrier conductor layer to said first ~~N₂~~^{N₂} reducing gas atmosphere is conducted at a temperature of 250-500°C (see column 7, lines 19-20);

(4) wherein said second reducing gas atmosphere is selected from any or more of hydrogen and nitrogen (see column 7, lines 18-19);

(5) wherein said step of exposing said metal film to said second reducing gas atmosphere is conducted at a temperature of 250-500°C (see columns 7 and 8, lines 62-67 and lines 1-7, respectively).

Lee teaches the above outlined features except for a CVD process and ^{a first} reducing gas atmosphere. However, Akahori discloses a method for forming a thin film for a semiconductor device (1)..... by a CVD process (see column 10, lines 52-57); exposing said barrier conductor layer to a first reducing gas atmosphere at an elevated substrate temperature (see column 13, lines 49-53);. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the above references to fabricate a semiconductor device by employing the well-known process and materials to improve its performance.

Claims 2 and 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U.S. 5,665,659) in view of Kajita et al. (U.S. 5,953,634)

Lee teaches the above outlined features except for a CVD process, copper film and tantalum or tantalum nitride. However, Kajita discloses a method for manufacturing semiconductor device (2) wherein said first reducing gas atmosphere is selected from

any of the group consisting of silane, ammonia and hydrogen (see column 12, lines 24-28); **(6)** wherein said metal film is a Cu film (see column 12, line 24); **(7)** wherein said barrier conductor layer is formed of any of Ta or TaN (see columns 11 and 12, lines 66-67 and lines 1-3, respectively). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the above references to fabricate a semiconductor device by employing the well-known process and materials to improve its performance.

Claims 8-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buchwalter et al. (U.S. 6,261,951 B1) in view of Lui et al. (U.S. 6,159,857)

Buchwalter discloses a plasma treatment method to enhance inorganic dielectric adhesion to copper by

(8) forming a barrier conductor layer on a substrate;

exposing said barrier conductor layer to a plasma of a reducing gas at an elevated temperature;

forming, after said step of exposing said barrier conductor layer to said

plasma, a metal film on said barrier conductor layer by a CVD process;

(9) wherein said reducing gas is hydrogen (see column 5, lines 1-6);

(10) wherein said step of exposing said barrier conductor layer to said plasma is conducted at a temperature of 50-400°C (see column 5, lines 10-18).

Buchwalter teaches everything above except for barrier materials, copper layer, and annealing process of metal layer. However, Lui discloses a method for cleaning

exposed copper excess surfaces in damascene structures with **(8)**..... of any of tungsten nitride or tantalum nitride (see column 3, lines 5-6); **(11)** further comprising, after said step of forming said metal film, a thermal annealing process applied to said metal film in a reducing gas atmosphere (see column 3, lines 34-36); **(12)** wherein said thermal annealing process is conducted at a temperature of 250-500°C (see column 3, lines 36-37); **(13)** wherein said metal film is formed of Cu (see column 3, line 8). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the above references to fabricate a semiconductor device by employing the well-known process and materials to improve its performance.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buchwalter et al. (U.S. 6,261,951 B1) in view of Kajita et al. (U.S. 5,953,634)

Buchwalter discloses a plasma treatment method to enhance inorganic dielectric adhesion to copper by

(14) alternately and repeatedly forming, on a substrate, an insulating film, a barrier conductor layer, wherein a step of exposing said barrier conductor film to a plasma of a reducing gas at an elevated temperature is interposed between said step of forming said barrier conductor layer and said step of forming said metal film (see columns 4 and 5, lines 4-67, and lines 1-18, respectively).

Buchwalter teaches everything above except for tungsten nitride and tantalum nitride as materials for barrier layer, and a metal film formed by a CVD process. However, Kajita discloses a method for manufacturing semiconductor device **(14)**.....

of any of tungsten nitride and tantalum nitride (see columns 11 and 12, lines 66-67 and lines 1-3, respectively), and a metal film, said metal film being formed by a CVD process (see column 12, lines 24-28). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the above references to fabricate a semiconductor device by employing the well-known process and materials to improve its performance.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Lee et al., Buchwalter et al., Kajita et al., Akahori et al., and Lui et al. disclose a method for forming metal layer of a semiconductor device.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chuong A Luu whose telephone number is (703)305-0129. The examiner can normally be reached on M-F (7:30-4:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (703)308-1323. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

CAL


CARIDAD EVERHART
PRIMARY EXAMINER